International Journal of Mechanical and Production
Engineering Research and Development (IJMPERD)
ISSN (P): 2249-6890; ISSN (E): 2249-8001
Vol. 9, Issue 3, Jun 2019, 53-60

DESIGN & ANALYSIS OF IMPROVISED CLUTCH PEDAL LINKAGE MECHANISM USING CATIA V5

JEBAROSE JULIYANA. S & UDAYA PRAKASH. J

Department of Mechanical Engineering, Vel Tech Rangarajan Dr. Sagunthala

R&D Institute of Science and Technology, Chennai, India

ABSTRACT

In the contemporary world of nowadays uncountable innovations has embark within the automobile sectors within the gift decades. The expected speed demand of the vehicle guides the foot pedal to interact or disengage the clutch plate. The linkages of foot pedal are the important elements that connect and actuate the hydraulic cylinder that produces the clutch plate to be engaged or disengaged. In serious vehicles because the foot pedal too removed from clutch plate the foot pedal linkage mechanism occupies extra space and there's time delay in transmission. Within the existing system because the linkages are too long the force applied is additional however the output force are less. During this improvised linkage mechanism, the dimensions of the linkages and also the position of the hydraulic cylinder is changed and analyzed with CATIA V5 software. The theoretical calculations also are disbursed to search out the force in each the changed and within the existing system.

KEYWORDS: Clutch Pedal, Linkages, CATIA, Driver's Comfort & Torque

Received: Mar 02, 2019; **Accepted**: Mar 22, 2019; **Published**: Apr 10, 2019; **Paper Id**.: IJMPERDJUN20196

Original Article

INTRODUCTION

The quality of the automobile design is reflected by the comfort of the drivers. The pedal motion and pedal force have a direct effect on driver's fatigue [Li, et al, 2013, Kyung, G. & Nussbaum, 2008]. Nima Jamshidi et al (2016) investigated, how the torque actuated helps to control the break and clutch pedal which is used in agricultural sectors. The farm tractor used in agriculture is impacting discomfort in the body of the drivers in many aspects such as leading to neck, knee, arm, shoulder and leg dis-comforts. Romain Pannetier (2013) discussed the clutching movements of pedal configurations for identifying the discomfort. Pedals in vehicles play a major role in controlling the vehicles. Only limited research work is available for the comfort of pedal operations. Some clutch pedal design recommendations provided in this study helps the engineers, where one wants to optimize its position. C. R. Mehta **(**2006) elaborately explained how it strengthens the legs of the operator who involved in the operation of tractor pedals. This literature concerns about how human strength was employed in the operation of the clutch pedal control. This study highly quantifies the Indian operator's human strength in the tractor pedal control. Karthikeyan Rajendiran (2014) in his single pedal control, he has designed acceleration mechanism and clutch mechanism that was integrated. The mechanical linkages were placed at the end of the pedal in his design and as a result the acceleration mechanism is counter balanced. Due to the acceleration mechanism the rod extends and it operates the clutch due to the generated torque. Purohit, et al, (2014) designed the friction clutch assembly by solidworks. So in this research paper instead of fabricating a modified clutch pedal, to be cost effective an attempt is made to design the modified clutch pedal by CATIA V5 software and the analysis is done by ANSYS software.

The input and output torque of the present brake pedal is compared with the input and output of the modified clutch pedal to check its feasibility.

CLUTCH PEDAL

The clutch linkage is a rendezvous of mechanical and typically hydraulic parts. A mechanical clutch linkage usually consists of the clutch pedal, a series of linkage rods and arms, or a cable. A hydraulic clutch linkage typically includes a clutch master cylinder and reservoir, a hydraulic line and a slave cylinder. Hydraulic linkages became more and more common as a result of them offer the manufacturer the pliability to extend force at the clutch fork, with fewer space constraints compared to mechanical linkages [Kolich, M., 2008]. The mechanism of clutch linkages have many rods and levers that transfers the motion from the clutch pedal to the fork of the clutch. By giving the force on the pedal the clutch fork moves forward by the bell crank that is activated by the pushrod. In Floor Mounted type, due to complexity of the system the material cost is more and also driver must apply his full effort to actuate the clutch pedal. The human strength was employed in the operation of the clutch pedal control [Wang, et al 2000, Gmurowski & Orr, 2003]. This study highly quantifies the vehicle operator’s strength in the tractor pedal control. Therefore in this project we modified the existing system and used simple mechanisms which will produce more output torque from the less torque. Figure 1 shows the methodology of the research work.

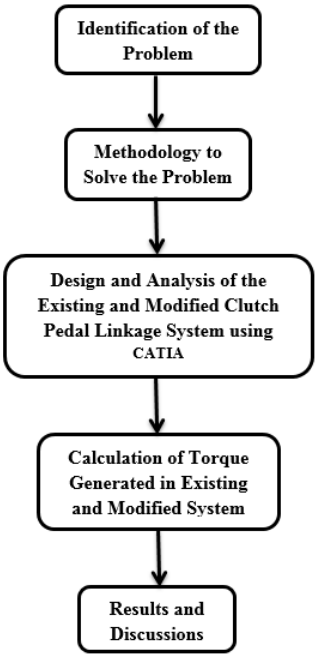

Figure 1: Research Methodology

DESIGN AND ANALYSIS OF THE SYSTEM

Mild steel is one in all the foremost common materials within the world, representing an associate degree business that produces one 3 billion tons a year, and it's a cloth used throughout the development of the many subject fabrications. There are several sub-categories of steel and reckoning on the assorted qualities and characteristics of a specific build, the selection of steel elite might vary. The properties that fluctuate the foremost between steel sorts are strength, ductility, hardness, aesthetics, and cost. Reckoning on your scope of labour, choosing the correct steel kind for the task will profit

the standard of the project and price.

Existing Model of Viking System

Figure 2 shows the Existing model of Floor mounted type. In this system when the clutch pedal is pressed it first moves the arc to 19 mm inner and slide the first linkage to 90 degree. When the first slide moves its automatically slides another slide which is attached to the piston. When the piston moves 40 mm inner side of the hydraulic cylinder it actuates the clutch pedal.

Due to this time delay a driver need to apply his full torque to actuate the clutch pedal to change the gear. So we focused our project in this area. At the end of pedal by having mechanical linkage, acceleration mechanism is neutralized and a further torque extends the rod which operates the clutch. Specification of the Floor Mounted Viking System is given in Table 1.

Table 1: Specification of the Floor Mounted Viking System

Sl. No.	Specifications	Existing System (mm)	Modified System (mm)
1	Width of the Frame	280	280
2	Length of the Pedal	120	120
3	Width of the Pedal	25	25
4	Length of the arc	185	185
5	Length of the Major Link	380	160
6	Distance of the major link from arc	140	230
7	Length of the Connecting Rod	100	100
8	Length of the Piston	90	50
9	Length of the Piston when actuated	60	20
10	Distance of the piston from frame base	90	433
11	Length of the hydraulic Cylinder	120	100
12	Width of the Hydraulic cylinder	35	35
13	Distance of the cylinder from the base	72.5	283
14	Length of the Spring	150	70

Due to now delay and material value was additional and additionally a driver got to apply his full force to actuate the foot pedal to alter the gear. Therefore, we have a tendency to target our research during this space.

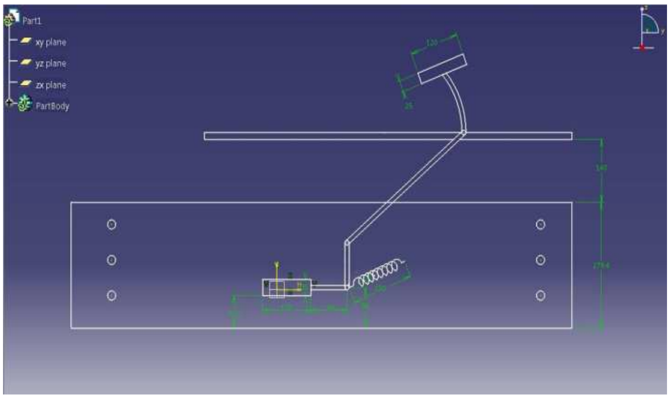

Figure 2: Existing 2D Diagram

Figure 3 shows the three dimensional diagram of the existing Viking model

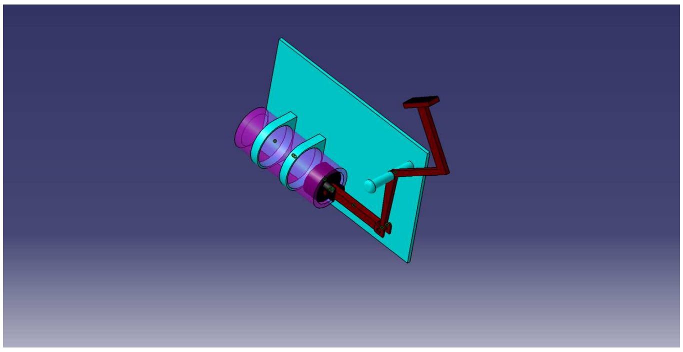

Figure 3: Existing 3D Diagram

Modified Model of Viking System

In this modified system, when the clutch pedal is pressed it directly actuate the hydraulic cylinder through piston. Due to this system the time delay is reduced and material usage also gets reduced. The modified system is shown in figures 4 & 5.

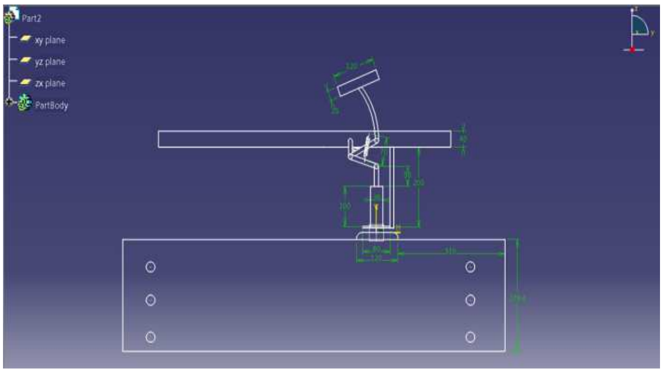

Figure 4: Modified 2D Diagram

Figure 5 shows the three dimensional diagram of modified system

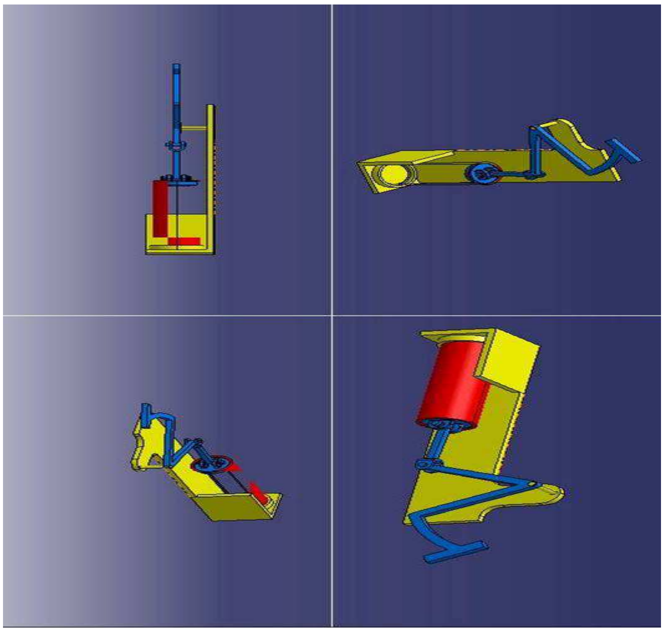

Figure 5: Modified 3D Diagram

The Analysis of modified system is done by CATIA V5 work bench. Generative structural analysis is beneficial to accumulate the varied structural characteristics of elements and product in a very 3D atmosphere. Victimization these tools permits you to investigate parts or product to see their structural qualities before they're factory-made. The Generative Structural Analysis workbenches utilize the Finite part technique of numerical approximation. This technique works by approximating the model by breaking it down into smaller, a lot of simplified items. These lessened items are remarked as elements. CATIA V5 Analysis provides the flexibility design simulations inside the CATIA design atmosphere, permitting constructors to directly analyze their main reference model in CATIA. Since there's no transfer of pure mathematics, issues with information integrity are avoided.

The displacement, stress, and strain diagrams are plotted in solid works (Figures 6, 7 & 8) by choosing the material as steel and analysis was done on the three dimensional model of the modified clutch pedal. From the figures it is clear that, the maximum stress is within yield stress.

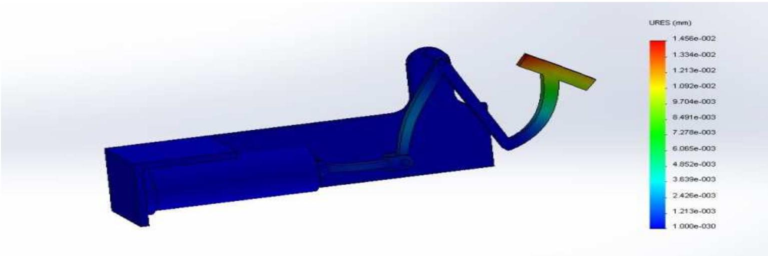

Figure 6: Displacement of Modified System

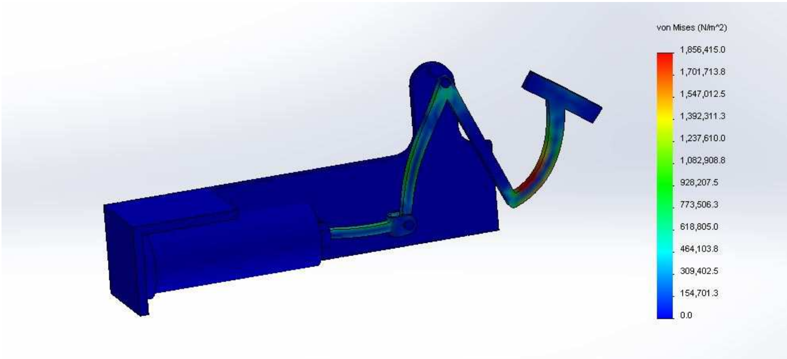

Figure 7: Stress of Modified System

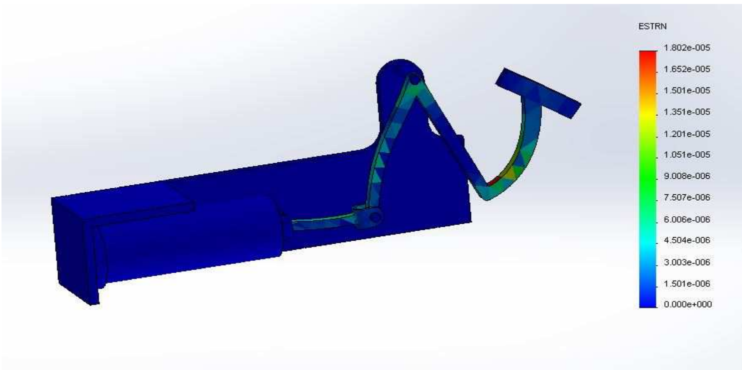

Figure 8: Strain of Modified System

RESULTS AND DISCUSSIONS

Theoretical calculations are carried out to find the torque generated in both the existing and modified system. The obtained results show that by applying identical force to each of the system more output is obtained in modified system than the existing system. The graph represents the variation within the output. The reason for the enhancement of the system is reduction of the length of the linkages, which in turn reduces the driver's fatigue and enhances the comfort of the driver. A graph is drawn between torque input and output and is shown in figure 9.

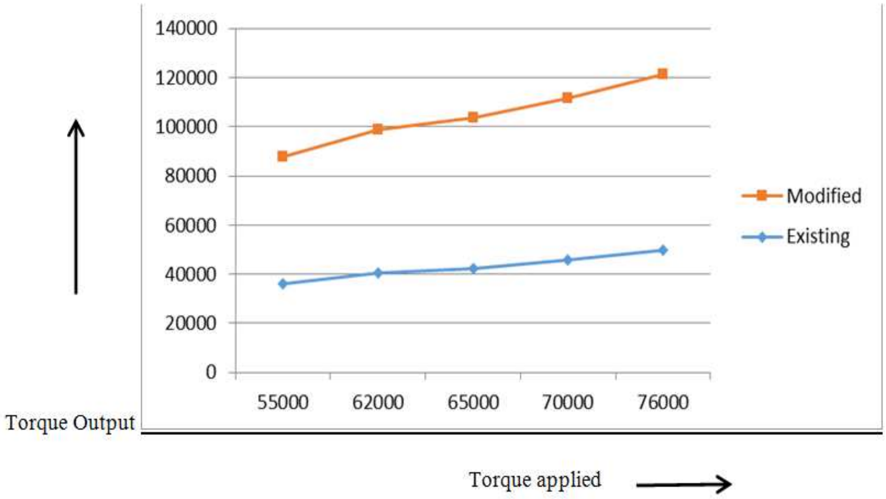

Figure 9: Torque applied Vs Output Torque

Table 2: Torque applied Vs Output Torque

Torque Applied in N-mm	Torque Output in Existing System in N-mm	Torque Output in Modified System in N-mm
55000	35970	51810
62000	40548	58404
65000	42510	61230
70000	45780	65940
76000	49704	71592

CONCLUSIONS

- More output torque was yielded for the same input torque by modifying the linkage mechanism.
- This design can be implemented, while designing heavy vehicles in the near future.
- The mechanism is simple and the material cost is reduced.
- Clutch efficiency is increased.

REFERENCES

1. *Gmurowski, W. W. and Orr, B. N., Delphi Technologies Inc, 2003. Adjustable pedal assembly. U. S. Patent 6, 571-660.*
2. *Jamshidi, N., Abdollahi, S. M., & Maleki, A., (2016). A survey on the actuating force on brake and clutch pedal controls in agricultural tractor in use in Iran. Polish Annals of Medicine, 23(2), 113-117.*
3. *Jebarose Juliyana, S, Udaya Prakash, J, Karthik, K, Pallavi, P & Saleem, M 2017, 'Design and Analysis of NACA4420 Wind Turbine Aerofoil using CFD', International Journal of Mechanical Engineering and Technology, 8(6), 403-410.*

4. *Pinninti, R. R. Design and Structural Analysis of Disc Brake in Automobiles.*
5. *Jebarose Juliyana, S, Udaya Prakash, J, Pallavi, Paturu & Divya Sadhana, A 2017, 'Finite Element Analysis of Mono Composite Leaf Spring of Varying Thickness and Varying Width used in Automotives', International Journal of Mechanical and Production Engineering Research and Development, 7(6), 247-254.*
6. *Karthikeyan Rajendiran, & Mohammed Sameer H. M. (2014) Clutch Pedal Acceleration. International Journal of Science and Research, 3(10), 414-419.*
7. *Kolich, M., (2008). A conceptual framework proposed to formalize the scientific investigation of automobile seat comfort. Applied Ergonomics, 39(1), 15-27.*
8. *Kyung, G., & Nussbaum, M. A., (2008). Driver sitting comfort and discomfort (part II): Relationships with and prediction from interface pressure. International Journal of Industrial Ergonomics, 38(5-6), 526-538.*
9. *Li, J., Deng, F., Liu, S. & Hu, H., (2013). Analysis of the influence of clutch pedal to vehicle comfort. Proceedings of the FISITA 2012 World Automotive Congress (pp. 15-20). Springer, Berlin, Heidelberg.*
10. *Mehta, C. R., Tiwari, P. S., Rokade, S., Pandey, M. M., Pharade, S, & Yadav, S. B., (2007). Leg strength of Indian operators in the operation of tractor pedals. International journal of industrial Ergonomics, 37(4), 283-289.*
11. *Kumar, M., & Singh, B. Ergonomic Analysis Of Electric Auto Rickshaw Using Catia.*
12. *Pannetier, R., & Wang, X., (2014). A comparison of clutching movements of freely adjusted and imposed pedal configurations for identifying discomfort assessment criteria. Applied Ergonomics, 45(4), 1010-1018.*
13. *Purohit, R., Khitoliya, P., & Koli, D. K., (2014). Design and finite element analysis of an automotive clutch assembly. Procedia Materials Science, 6, 490-502.*
14. *Wang, X., Verriest, J. P., Lebreton-Gadegbeku, B., Tessier, Y., & Trasbot, J., (2000). Experimental investigation and biomechanical analysis of lower limb movements for clutch pedal operation. Ergonomics, 43(9), 1405-1429.*